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09/809,423	03/16/2001	Jens Klein		4925

7590 03/08/2006  
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EXAMINER

SODERQUIST, ARLEN

ART UNIT PAPER NUMBER

1743

DATE MAILED: 03/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/809,423

Applicant(s)

KLEIN ET AL.

Examiner

Arlen Soderquist

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 39,41-45,47,48 and 50-76 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 39,41-45,47,48 and 50-76 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 December 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 12-20-05.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

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1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on December 20, 2005 has been entered.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 39, 41-45, 47-48 and 50-76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Willson (either WO 97/32208, Willson '208 or US 6,063,633, Willson '633) or Akporiaye (US 6,627,445) in view of Anderson, Cong (newly cited and applied), Choudhary, Jain or TamizhMani and Fawcett, Clausen, Hunger, Latzel, LeBlond, Moon, Newman, Topspe or Watanabe.

Both Willson '208 and Willson '633 come from the same application and therefore contain the same disclosure. While this explanation of the Willson references will refer to the Willson '633 patent, corresponding disclosure is found in the Willson '208 application. Willson '633 teaches a catalyst testing process and apparatus. In column 1 lines 27-40, Willson '633 teaches that catalyst testing was conventionally accomplished in bench scale or larger pilot plants in which the feed is contacted with a catalyst under reaction conditions, generally with effluent products being sampled, often with samples being analyzed and results subjected to data resolution techniques. Those procedures can take a day or more for a single run on a single

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catalyst. While those techniques have value in fine-tuning the optimum matrices, pellet shape, etc., the Willson '633 invention permits the scanning of dozens of catalysts in a single set-up, ***often in less time than required for a single catalyst to be evaluated by conventional methods.*** Further, when practiced in its preferred robotic embodiments, the invention can sharply reduce the labor costs per catalyst screened. In the apparatus and method a multicell holder e.g. a honeycomb (microchannel array) or plate, or a collection of individual support particles, is treated with solutions/suspensions of catalyst ingredients to produce cells, spots or pellets holding each of a variety of combinations of the ingredients, is dried, calcined or treated as necessary to stabilize the ingredients in the cells, spots or pellets, then is contacted with a potentially reactive feed stream or batch e.g., biochemical, gas oil, hydrogen plus oxygen, propylene plus oxygen,  $\text{CCl}_2\text{F}_2$  and hydrogen, etc. The reaction occurring in each cell can be measured, e.g. by infrared thermography, spectroscopic detection of products or residual reactants, or by sampling, e.g. by multistreaming through low volume tubing, from the vicinity of each combination, followed by analysis e.g. spectral analysis, chromatography etc, or by observing temperature change in the vicinity of the catalyst e.g. by thermographic techniques, to determine the relative efficacy of the catalysts in each combination. Robotic techniques can be employed in producing the cells, spots, pellets, etc. Columns 2-3 summarize some of the aspects of the invention including reaction types, sensors, catalyst taggants and reactions conditions. The reaction types include any reaction enhanced by the presence of a catalyst such as polymerization reactions, halogenation, oxidation, hydrolysis, esterification, reduction and any other conventional reaction which can benefit from a catalyst. Hydrocarbon conversion reactions, as used in petroleum refining are an important use of the invention and include reforming, fluid catalytic cracking, hydrogenation, hydrocracking, hydrotreating, hydrodesulfurizing, alkylation and gasoline sweetening. The sensors used to detect catalytic activity in the candidate catalysts include chromatographs, temperature sensors, and spectrometers. Especially those adapted to measure temperature and/or products near each specific catalyst spot e.g. by multistreaming, multitasking, sampling, fiber optics, or laser techniques such as thermography, as by an infrared camera recording the temperature at a number of catalyst sites simultaneously, NMR, NIR, TNIR, electrochemical, fluorescence detectors, Raman, flame ionization, thermal conductivity, mass, viscosity and stimulated electron

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or X-ray emission. Optionally taggants (labels) can be added to identify particular catalysts, particularly where particles are employed as supports for the catalysts. These taggants can be conventional as discussed in the literature. Taggants can be chemicals that are stable at reaction conditions or can be radioactive with distinctive emissions. The techniques of combinatorial chemistry will be applicable with taggants as well as with catalysts chosen to suit the particular reaction to be enhanced by the catalyst (some of the samples are selected based on the results). Temperatures, pressures, space velocities and other reaction conditions can be varied and will be determined by the reactants and reaction. The intent of the process is to screen for catalysts having improved properties for a desired reaction. Example 3 shows the selection being based on the presence of carbon dioxide in the product stream by using an appropriate wavelength of infrared radiation. Example 5 teaches the particles showing activity being collected and analyzed for the content of labeling materials to determine the composition of the material giving the desired catalytic activity. Willson '633 does not give examples of using two analysis methods together or selecting a subset of the total candidates for a second analysis method.

In the patent Akporiaye teaches apparatus and method for simultaneously evaluating a plurality of catalysts. The process involves containing the plurality of catalysts in an array of parallel reactors with each reactor containing a bed of catalyst. Each bed of catalyst is then simultaneously contacted, at reaction conditions, with a reactant to form an effluent of each reactor. The reactant or an inert fluid is at a space velocity sufficient to fluidize the catalyst beds. Each of the effluents is analyzed. Column 8, line 40 to column 9, line 47 discusses the analysis of the effluents and teaches that the effluents produced are ***analyzed using at least one analytical technique*** to determine whether products have been formed, how much product has been formed, and/or which specific product compounds have been formed. ***The analytical technique used may be any suitable technique for the type of information desired and components involved.*** Preferred techniques include, generally, chromatography, spectroscopy, and nuclear magnetic resonance. Various different forms of chromatography and/or spectroscopy may be employed. Examples include liquid chromatography, gas chromatography, ultraviolet absorption spectroscopy, visible absorption spectroscopy, ultraviolet-visible spectroscopy, atomic absorption spectroscopy, infrared absorption spectroscopy, and emission spectroscopy. While chromatography and spectroscopy methods are preferred, other acceptable techniques include

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but are not limited to fluorescence spectrometry, mass spectrometry, X-ray methods, radiochemical methods, electroanalytical methods, potentiometric methods, conductometric methods, electrogravimetric methods, coulometric methods, and voltammetry. At least a portion of the effluent from each reactor is conveyed to the analytical instrument. The effluents may be directly conducted to an analytical instrument, or aliquots of the effluents may be sampled and delivered to the location of the analytical instrument. The effluents may also be analyzed on stream as they are removed from the reactors. In evaluating catalyst performance, observing trends of activity, selectivity, and yield over time is valuable. Therefore, the effluent being withdrawn from each reactor may be periodically or continuously analyzed. The selectivity, activity, and/or yield may be determined at each analysis time, and the trend of the selectivity and activity may then be observed over time. It is preferred that the effluents of each of the reactors be sampled simultaneously. The benefit of simultaneous sampling is that the results from each catalyst bed are more readily comparable since each catalyst bed would be exposed to the reactant for the same period of time. For quantitative results, the amounts of the effluents analyzed are measured. The specific analysis performed depends upon the application and the desired information. For example, if only the activity of the plurality of catalysts is to be determined and compared, an analysis measuring the amount of reactant consumed in each effluent may be sufficient. Also, a qualitative analysis for the composition of the effluent could be used as an indication of catalyst activity. However, it is generally preferred to have both activity and selectivity information and, in that case, the analytical technique would be selected to measure the quantity of the different components present in each effluent. Using both the activity information and the selectivity information, the yield to the desired products can be calculated and compared between the individual catalysts or mixtures of catalysts that make up the plurality of catalysts (the intent is to select a group of the catalysts based on the result from the original group based on the first response. Column 8, line 61 to column 9, line 10 teaches that at least a portion of the effluent from each reactor is conveyed to the analytical instrument. The effluents may be directly conducted to an analytical instrument, or aliquots of the effluents may be sampled and delivered to the location of the analytical instrument. In another embodiment, the effluents may be analyzed on stream as they are removed from the reactors. In evaluating catalyst performance, observing trends of activity, selectivity, and yield over time is valuable.

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Therefore, the effluent being withdrawn from each reactor may be periodically or continuously analyzed as discussed above. The selectivity, activity, and/or yield may be determined at each analysis time, and the trend of the selectivity and activity may then be observed over time. Again it is preferred that the effluents of each of the reactors be sampled simultaneously so that the analysis results are directly comparable and the time that each catalyst has been exposed to the reactant is the same. For quantitative results, the amounts of the effluents analyzed are measured. Since the effluents can be measured continuously on stream as they are removed from the reactors and are simultaneously sampled, the effluents are also simultaneously measured. Akporiaye does not give examples of using two analysis methods together. Column 8, line 61 to column 9, line 10 teaches that at least a portion of the effluent from each reactor is conveyed to the analytical instrument. The effluents may be directly conducted to an analytical instrument, or aliquots of the effluents may be sampled and delivered to the location of the analytical instrument. In another embodiment, the effluents may be analyzed on stream as they are removed from the reactors. In evaluating catalyst performance, observing trends of activity, selectivity, and yield over time is valuable. Therefore, the effluent being withdrawn from each reactor may be periodically or continuously analyzed as discussed above. The selectivity, activity, and/or yield may be determined at each analysis time, and the trend of the selectivity and activity may then be observed over time. Again it is preferred that the effluents of each of the reactors be sampled simultaneously so that the analysis results are directly comparable and the time that each catalyst has been exposed to the reactant is the same. For quantitative results, the amounts of the effluents analyzed are measured. Since the effluents can be measured continuously on stream as they are removed from the reactors and are simultaneously sampled, the effluents are also simultaneously measured. Akporiaye does not give examples of selecting a subset of the total candidates for a second analysis method.

In the report Anderson discusses preliminary results from screening tests (furnace studies of catalyst activity) of commercial catalysts with potential use in gas turbine combustors. Thirty commercially produced monolith and pellet catalysts were tested as part of a screening process to select catalysts suitable for use in a gas turbine combustor. The catalysts were contained in a 1.8 centimeter diameter quartz tube and heated to temperatures varying between 300 and 1,200°K while a mixture of propane and air passed through the bed at space velocities of 44,000-

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70,000/hour. The amount of propane oxidized was measured as a function of catalyst temperature. Of the samples tested, the most effective catalysts proved to be noble metal catalysts on monolith substrates. The last paragraph of the summary (page 1) and the concluding remarks (page 9) teach that further tests will be required to determine the effects of aging after this preliminary screen.

In the paper Cong discusses combinatorial discovery of oxidative dehydrogenation catalysts within the Mo-V-Nb-O system. Combinatorial methodologies were used for the synthesis and screening of mixed metal oxide heterogeneous catalysts. Primary screening at low reactant conversions at a throughput of greater than 10,000 catalyst compositions per month was performed by using simultaneous mass spectroscopy and photothermal deflection spectroscopy (a first detector arrangement) on spatially separated thick film catalysts with  $\approx 200$  mg per catalyst prepared by using automated liquid dispensing. The first full paragraph of page 11078 teaches that the areas of high product yield (those above a certain limit or value) may be re-examined in the primary screen or in a secondary screen. Secondary screening under realistic operating conditions was performed at a throughput of greater than 3,000 catalyst compositions per month on  $\approx 50$  mg of catalyst in an array of fixed bed microreactors with gas chromatograph detection (a second detector). In the same paragraph the possibility of a tertiary screen is also taught. The paragraph bridging the columns of page 11078 teaches that the two detectors are used to allow differentiation of the compounds produced on the reaction because the ethylene product is a component of the mass spectral measurement of the ethane reactant. The approach was validated by the discovery of catalysts with superior performance to those previously described for the oxidative dehydrogenation of ethane to ethylene (Table 2). They show the full implementation and integration of combinatorial methodologies for synthesis, screening, discovery, and optimization of multicomponent heterogeneous catalysts.

In the paper Choudhary applies the group screening method to the selection of the best catalyst for the isomerization of n-butene to isobutene, as the first step in a detailed program of investigations on the mechanism and kinetics of this reaction. Forty-six acid-solid catalysts grouped according to their chemical similarities into twelve groups were tested for their performance in the conversion of n-butene to isobutene at 400 °C, atmospheric pressure and W/F



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= 40 [ratio of the catalyst weight (g) to the feed rate (gmole/hr)] in an integral-type reactor. Constituent catalysts of the group that appeared to contain the most promising catalysts were then tested independently under identical conditions in order to identify the best catalyst. Fluorinated  $\eta$ -alumina (1% F) was found to be the best catalyst, with the highest activity (conversion), good selectivity, appropriate life, and excellent regenerability. It was possible to identify the best catalyst in only 17 runs by the group screening method as against a minimum of 46 that would have been necessary if all the catalysts had been assessed independently (excluding life and regeneration tests in both cases). The last paragraph of page 58 shows that a selection criteria of conversion less than or equal to 6% was used to discard the majority of the groups. The three selected groups had their selectivity and conversion compared to select the best group (see table 2). A similar process was used to look at each member of the group that was selected based on this comparison (see table three and its associated discussion).

In the paper Jain presents studies on palladium/charcoal catalysts for isotopic exchange reaction in hydrogen/water medium. Catalysts with Pd loaded on activated charcoal supports were prepared and preliminary screening of the catalysts was done on the basis of copper (II) formate decomposition reaction. The selected catalysts were converted into hydrophobic pellets after blending with Teflon and tested in a static reactor for H-D exchange reaction between hydrogen gas and liquid water. Results indicated depletion of the D content of initially enriched hydrogen gas. The half reaction times were used to compare the activity of the different catalysts tested. It is noted that the catalysts selected for further testing had a reactivity (had a minimum threshold) that was above all of the other catalysts tested.

In the paper TamizhMani presents a rapid half-cell technique for the pre-screening of polymer fuel cell catalysts. Four platinum-based catalysts with different catalytic activity for the oxygen reduction reaction were prepared and tested in polymer fuel cells (PFCs) and in half-cells with H<sub>2</sub>SO<sub>4</sub> and HF electrolytes. The activity results of PFCs at 0.9 V vs. RHE (reversible hydrogen electrode) can be mimicked in parallel by the results obtained in HF electrolyte but not by the results obtained in H<sub>2</sub>SO<sub>4</sub> electrolyte. This paper concludes that the pre-screening of a huge number of Pt-based catalysts for the selection of potential catalysts for the PFCs can be carried out by a rapid half-cell technique with a nonadsorbing electrolyte such as HF. The paragraph bridging pages 121-122 teaches that the PFC test is time consuming and expensive

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and the intent of the paper is to show that the rapid test can mimic the complete test. The conclusion teaches that this rapid test will be used to select the candidates for the more time consuming test.

In the paper Fawcett describes a new instrument. Three powerful analytical techniques, differential scanning calorimetry (DSC), x-ray diffraction (XRD), and mass spectrometry (MS) were combined so that one can completely characterize materials as they are heated in controlled atmospheres. The XRD capability tells, continuously, about the structure of the solid phase in the reaction chamber. The MS monitors the volatiles. And the DSC tells about reaction and phase-change thermochemistry. The set-up was used to study the melting behavior of polymers, the mechanisms of reduction in copper catalysts, and the thermal processing of pharmaceuticals. The combined instrument has several advantages over analyses where the 3 techniques are run separately. The simultaneous analysis allows the analyst to assign specific structural or chemical process data directly to observed thermal events. Because the same environment and sample are used for all 3 analyses, instrumental and sample preparation conditions and errors associated with them are kept constant.

In the paper Clausen teaches an in situ cell for combined XRD and on-line catalysis tests of copper-based water gas shift and methanol catalysts. A newly developed in situ x-ray diffraction (XRD) cell was used to obtain information on the structure of binary Cu-Zn and ternary Cu-Zn-Al catalysts during reduction and water gas shift and MeOH synthesis. A major advantage of the cell is that it also serves as an ideal plug flow catalytic reactor such that realistic catalytic and structural information can be obtained simultaneously on the same sample. The cell can be operated both at high temperatures and high pressures. Direct MeOH activity tests confirmed the suitability of the cell. By use of x-rays from a synchrotron source, dynamic studies on the time scale of seconds are demonstrated. This feature was used to study the phase transformation occurring during the activation of the calcined catalysts. In the active catalysts, Cu metal is the only crystalline Cu phase observed, and the formation of this phase is closely related to the disappearance of CuO in the calcined catalyst. The XRD results provide detailed information on the nucleation and growth processes. The variation in the water gas shift activity correlates with the changes in the Cu surface area.

In the paper Hunger presents a technique for simultaneous in-situ MAS NMR and online gas chromatographic studies of hydrocarbon conversions on solid catalysts under flow conditions. A new technique was introduced for simultaneous in-situ MAS NMR investigations of hydrocarbon conversions on solids under flow conditions and online gas chromatography. For adsorption of MeOH on zeolite H-Beta, equal amounts of adsorbed molecules were determined by both analytical methods. Studying the synthesis of Me tert-Bu ether (MTBE) on zeolite H-Beta using an MAS NMR rotor reactor, a constant yield of MTBE of 27% was obtained up to a weight hourly space velocity of  $1.4 \text{ h}^{-1}$ . The variation of the reaction temperature led to a simultaneous change of the  $^{13}\text{C}$  MAS NMR signals of isobutoxy species and of the yield of MTBE determined by online gas chromatography, which indicated that isobutoxy species act as the chemically active compounds. In this first application, the new in-situ technique has demonstrated its advantage for a simultaneous investigation of compounds with a long residence time on the catalyst surface and of compounds rapidly leaving the catalyst surface.

In the paper Latzel teaches a rapid method for catalyst activity measurements by combination of pulse reactor, mass spectrometer and process computer. The combination of a pulse reactor attached directly (without a separation column) to a mass spectrometer-process computer system is described. In order to obtain a conversion-temperature diagram for the dehydration and dehydrogenation of 2-butanol <1 h is required. Therefore, the method can be used for rapid characterization or comparison of the activities of various samples. The figure of page 394 and its associated discussion teach a temperature measurement at the same time the conversion is being measured by the mass spectrometer.

In the paper LeBlond presents a combined approach to characterization of catalytic reactions using in situ kinetic probes. Several in situ probes for continuously monitoring rate of catalytic reactions under reaction conditions are described. They are reaction calorimetry, measurements of hydrogen uptake in the case of hydrogenation, and IR spectroscopy. In studying catalytic hydrogenation reactions, for example, these in situ probes provide kinetic details of the reactions from different perspectives over the entire course of the reaction. The reaction calorimetry and the hydrogen uptake measure directly, continuously, and in a non-invasive manner the rate of reaction, while the in situ IR spectroscopy provides time-resolved compositional information in the liquid phase. A combination of the information thus obtained

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leads to a clear and coherent kinetic picture of the reaction under study. This can greatly facilitate pathway analysis and mechanistic description of the catalytic reaction. In this report, the usefulness of the combination of these in situ probes is illustrated with two examples of heterogeneously-catalyzed hydrogenation reactions.

In the patent Moon describes a catalyst characterization apparatus capable of characterizing the surface of a catalyst more accurately by a volumetric method without requiring a pre-treatment step, which may vary the characteristics of the catalyst as well as without exposing the catalyst in air, by combining a dynamic flow type reactor with a volumetric type adsorption apparatus. With this apparatus it is possible to accurately characterize the catalyst during an actual reaction. It is possible to accurately characterize the various catalysts and to characterize the catalyst during the reaction, alternately and/or continuously, by combining a dynamic flow type reactor with a volumetric type characterization apparatus as well as a dynamic flow type characterization apparatus. The figures show both a gas chromatograph (16) and mass spectrometer (17) connected to the reactor (14) in parallel.

In the paper Newman presents a study of model copper-based catalysts by simultaneous differential scanning calorimetry, x-ray diffraction and mass spectrometry. The results of this study show  $\text{Cu}_2\text{O}$  as an intermediate in the reduction of the  $\text{CuO}$  portion of each of the model catalysts. Such features as the onset temperature and  $\text{Cu}$  surface area varied widely among the 4 catalysts in response to the same chemical event conducted under similar experimental conditions. Oxidation runs on the reduced catalysts were all similar, 1 producing  $\text{Cu}_2\text{O}$  from metal over a broad range of temperature, followed by the oxidation of  $\text{CuO}$  at even higher temperatures.

In the paper Topspe teaches combined in-situ FTIR and on-line activity studies applied to vanadia-titania  $\text{DeNO}_x$  catalyst. An approach for performing combined in-situ FTIR and online activity measurements is described. The application of such studies to  $\text{V}_2\text{O}_5\text{-TiO}_2$   $\text{DeNO}_x$  catalysts is given. The trends in catalytic activity measured directly with the FTIR cell/reactor agreed with separate activity measurements demonstrating that the present experimental approach provides a direct link between the surface chemistry and the catalysis. During the  $\text{DeNO}_x$  reaction conditions, both Brønsted and Lewis acid sites are present on the surface and

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they adsorbed  $\text{NH}_3$  strongly. The surface V-OH and V = O groups are probably involved in the catalytic reaction.

In the paper Watanabe discusses dissociation reactions of carbon monoxide gas on iron and iron oxide ( $\text{Fe}_2\text{O}_3$ ) surfaces observed by Raman-ellipsometry spectroscopy. A combined system of Raman spectroscopy and ellipsometry was developed for the study of catalyst surfaces on which a chemical reaction is taking place. The dielectric function and the thickness of a surface layer or a surface compound produced in the reaction are analyzed by ellipsometry; vibrational modes of the compound and surface species are analyzed by Raman spectroscopy, and the products in the gas phase by mass spectrometry. The system was applied to the study of the Boudouard and dissociation reactions of CO molecules in Fe and  $\text{Fe}_3\text{O}_4$  catalysts. A surface layer produced by diffused C and O atoms, a thin oxide layer produced on Fe by CO dissociation, and graphite layers produced by the Boudouard reaction were analyzed. Raman spectra reveal the existence of several kinds of C species, such as defective graphite and an iron carbide formed on the Fe and  $\text{Fe}_3\text{O}_4$  surfaces. Several Raman bands may be due to microscopic clusters of surface graphite. The reaction of the defective graphite with  $\text{H}_2$  gas is stepwise on a time scale of seconds.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a combination of appropriate analysis methods taught by any of Willson '633, Willson '203, Akporiaye, Clausen, Cong, Hunger, Latzel, LeBlond, Moon, Newman, Topspe or Watanabe in the Willson '633, Willson '203 or Akporiaye methods and apparatus because of the clear advantages taught by Fawcett, Clausen, Cong, Hunger, Latzel, LeBlond, Moon, Newman, Topspe or Watanabe when more than one analysis method is used on the same sample. Since the Willson '633, Willson '203 or Akporiaye methods and apparatus are intending to select catalyst formulations from those tested, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use first analysis method to select candidates for a second analysis method as taught by Anderson, Choudhary, Cong, Jain or TamizhMani on those catalysts selected with the initial measurement technique as shown in example 5 of Willson '633 or Willson '203 because of the ability to further select among the catalyst formulations which is the intent of the Willson '633, Willson '203 or Akporiaye methods and apparatus and the ability

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to reduce the number of times a more expensive or time consuming test needs to be performed as taught by Choudhary or TamizhMani or to increase the throughput and determine possible catalyst compositions that are different and better than known catalyst compositions as taught by Cong.

4. Applicant's arguments filed December 20, 2005 have been fully considered but they are not persuasive. Relative to the obviousness rejections, Willson and Akporiaye teach all of the elements except the provision of two detectors with the second one used to analyze the better candidates measured by the first detector. The Willson references further teach an example in which the catalysts showing activity in the first measurement are analyzed a second time to determine the composition of the catalyst (example 5). The secondary references clearly show that there are benefits to having two detectors to characterize the catalyst samples. Among these the newly cited and applied Cong reference teaches a first and second screen with the second screen done on a subset of the first screen. This reference also clearly teaches that the better catalyst compositions can be re-evaluated in the primary screen. These references clearly show that one of skill in the art would have understood the benefit of using a plurality of detectors for simultaneous analysis of the catalyst and or the various aspects of the catalytic reaction. Additionally, regarding the selection of the second set based on the results of the first set examiner notes that the newly cited and applied Cong reference clearly show a selection process in which a first sensor is used to select materials for evaluation by a second sensor. The Choudhary and Cong references clearly show at least one limit used to select the catalysts for further examination. Further, since the Willson '633, Willson '203 or Akporiaye methods and apparatus compare the results to select catalyst formulations from those tested, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the second analysis method on those catalysts selected with the initial measurement technique because of the ability to further select among the catalyst formulations as is the intent of the Willson '633, Willson '203 or Akporiaye methods and apparatus. Relative to the second sensor, Cong clearly teaches different sensors in the primary and secondary screens. It should be pointed out that a different parameter could be the concentration of a product that is not measured by the first sensor. Or it could be that the first sensor is measuring the presence of a

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product such as a UV spectrometer while the second sensor measures the molecular weight of the product(s) measured by the UV sensor.

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additional references are related to catalyst testing and selection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arlen Soderquist whose telephone number is (571) 272-1265. The examiner can normally be reached on Monday-Thursday and Alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jill Warden can be reached on (571) 272-1267. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
Arlen Soderquist  
Primary Examiner

# Replacement Sheet

FIG. 1

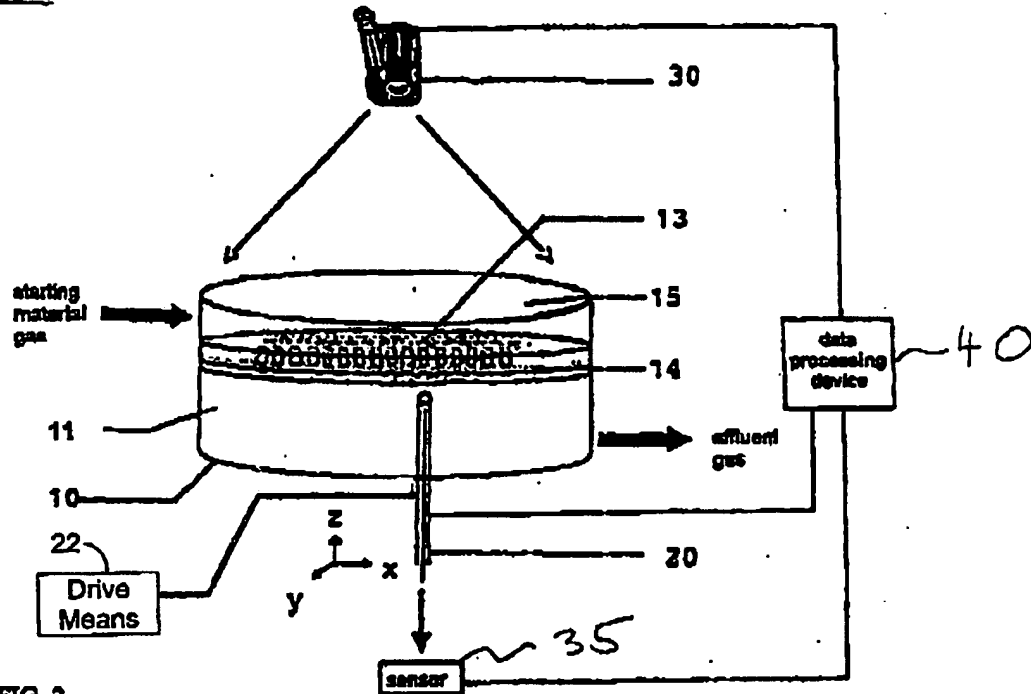


FIG. 2

